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EDUCATION RESEARCH AND ITS RELATION TO POLICY, AN ANALYSIS BASED ON THE EXPERIENCE OF THE UNITED STATES.

BY- BRIGHT, R. LOUIS GIDEONSE, HENDRIK D.

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TO STIMULATE DISCUSSION ABOUT SUPPORT FOR EDUCATIONAL RESEARCH AND DEVELOPMENT, A PRESENTATION WAS MADE AT A PROFESSIONAL MEETING IN OCTOBER 1967, DESCRIBING THE NATURE OF SUCH ACTIVITIES, DISCUSSING SOME OF THE ISSUES RELATING TO THE ADMINISTRATION OF RESEARCH, AND REVIEWING THE EXPERIENCE OF THE UNITED STATES. DIVIDED INTO THREE MAIN SECTIONS, THE PAPER CONCENTRATES ON THE NATURE AND MANAGEMENT OF AND THE RESOURCES FOR EDUCATION RESEARCH, EXPLORES THE EVOLUTION OF THE AMERICAN EXPERIENCE, AND SPECULATES ON THE POLICY IMPLICATIONS FOR EDUCATION NOW ARISING AS A CONSEQUENCE OF RESEARCH AND DEVELOPMENT ACTIVITIES CURRENTLY BEING SUPPORTED. PARTICULAR ASPECTS OF EDUCATIONAL RESEARCH REVIEWED INCLUDE FINANCIAL RESOURCES, MANPOWER RESOURCES, EMERGENT UNITED STATES STRATEGY FOR EDUCATIONAL RESEARCH, CURRENT EMPHASES FOR THE RESEARCH PROGRAM, FUNDAMENTAL STUDIES, PERSONNEL DEVELOPMENT, DISSEMINATION OF NEW TECHNIQUES, AND FINANCIAL IMPLICATIONS. MAJOR EDUCATIONAL POLICY AND PLANNING DECISIONS ARE RELATED TO CURRENT RESEARCH ACTIVITIES IN FOUR MAIN AREAS--HUMAN GROWTH AND DEVELOPMENT, SOCIAL FACTORS AND LEARNING, NEW INSTRUCTIONAL TECHNIQUES AND CURRICULA, AND COMMUNICATION AND COMPUTER TECHNOLOGY. AN OUTPUT-ORIENTED MODEL OF RESEARCH AND DEVELOPMENT AND THEIR RELATIONSHIP TO EDUCATIONAL IMPROVEMENT IS APPENDED. THIS PAPER WAS PREPARED FOR THE MEETING OF THE COMMITTEE FOR SCIENTIFIC AND TECHNICAL PERSONNEL, ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OCTOBER, 1967). (JK)

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EDUCATION RESEARCH AND ITS RELATION TO POLICY
An Analysis Based on the Experience of the United States

R. Louis Bright, Associate Commissioner for Research, United States Office of Education

Hendrik D. Gideonse, Director, Program Planning and Evaluation Staff, Bureau of Research, U.S.O.E.

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A decision to support research and development on the scale necessary to bring about major improvements in the process of instruction portends important consequences for the educational systems of all nations. It does so principally because it constitutes evidence of an intention to move directly toward providing more powerful techniques for learning and instruction rather than to rely on evolutionary processes for improvement.

There are at least three senses in which the making of such a decision can be discussed as a policy matter. First, what is the nature of such research, should it be supported, and how might a nation or group of nations go about doing so? Second, what are the specific substantive activities to be supported? What educational level, what subject matter areas, or what kinds of research on learning or motivation should be attended to? Finally, a third group of questions centers on the implications arising as a consequence of newly discovered knowledge or newly developed capabilities. What kinds of possibilities are opened to an educational system, or what kinds of new demands are made on it as a consequence of knowledge generated by research?

These three different aspects of the discussion of research as it relates to policy are virtually impossible to separate neatly from one another. When undertaking an analysis such as the one presented in this paper, it is necessary to concentrate on one aspect at a time, a

circumstance which lends an unfortunate aura of abstractness and artificiality to the discussion. The reader is asked to keep in mind that each aspect of research policy as it relates to education feeds into the others in integral ways, and the usefulness of concentrating on each one is fully realized only if one keeps in mind the existence of a continuing relationship to the others.

The purpose of this paper is to stimulate discussion about support for research and development for education by describing the nature of such activities, by discussing some of the issues relating to the administration of research, and by presenting for consideration the brief but significant experience of one nation in developing a research program for education.

The paper concentrates heavily on raising policy questions in the first sense described above. The first portion of the paper concentrates on a number of topics concerning the nature, management, and resources for education research. The analysis in this portion is of course based on and is an abstraction from the experience gained from the support of education research in the United States. The second portion of the paper explores the evolution of the American experience in education research. A third and concluding section speculates on the policy implications for education now arising as a consequence of research and development activities currently being supported in the United States and elsewhere. It is included as an illustration of the potential of research to affect educational policy.

I

EDUCATIONAL RESEARCH: ITS NATURE, RESOURCES, AND MANAGEMENT

Education Research Functions

No discussion of research for education can begin without first clarifying the character of its component functions or activities. There is no universal agreement on these points. It is therefore important to establish some rough guidelines.

The first function is fundamental study or basic research. It includes all those activities designed to produce knowledge about the learning process, to improve learning theory, to deepen our understanding of the fundamental chemical, biological, and neurological processes underlying learning, and to improve our understanding of motivation and its role in learning. Such studies may involve elaborately designed laboratory experiments or the large-scale collection of data from field settings.

Another example of basic research includes the effect of environmental influences on learning. Here sociologists, anthropologists, and psychologists seek to uncover the relationships between home, community, parental, socio-economic and other environmental variables to the learning of children and adults.

The social context of learning in instructional settings is also an appropriate area of study. The classroom or school as a social system, the effects of peer culture on learning, and larger political, sociological, cultural, and economic questions on the relationship between educational systems and the societies wherein they are found

are all prime objects of fundamental studies. Still other areas of fundamental study include small group processes, the affective domain, communications and information science, test and measurement theory, perception, the change process in education, and research methodology. Also included are data collection efforts associated with assessing the general progress of education exemplified by such studies as the Equal Educational Opportunities Survey conducted by James Coleman, the International Mathematics Study directed by Torsten Husen, or the proposed national assessment project under the general direction of Ralph Tyler.

A second function which is part of the research process is development. Development is the creation and validation of new practices, materials, processes, and organizational forms for instruction and education. Development is directed to the improvement of the processes by which the objectives of instruction and education are achieved.

Development begins with the careful description of practical needs in terms of objectives or performance specifications for materials or processes calculated to satisfy those needs. The first step in any development program, therefore, is a careful analysis of the problems that schools, communities, universities or the public may identify regarding learning, instruction, or education. This must then be followed by the specification of the desired objective. The way in which the objective is stated is all important; it must be phrased in terms of how a student will react to a specified condition and with sufficient preciseness to enable several independent observers to agree as to

whether or not a given student has attained the objectives.

Development as it is defined here includes what is frequently identified as applied research. We conceive of development as a very comprehensive process, including the identification of what is not known that is needed, the establishment of the necessary research projects to close those gaps, and the coordination and incorporation of the known, the available, and the newly discovered into the new effort.

The actual work of development is based on the principle of iteration. Each successive stage of the work is analyzed in terms of its failure to affect the student behavior specifications originally established, and the resulting feedback is then used to guide the next steps in the development effort in order to move the work to closer and closer approximations of the desired objectives.

A third function in the research process is the systematic dissemination of information relating to each of the functions identified above. Dissemination may be passive in the sense of an information storage and retrieval network pertaining to research for education, or it may be active in the form of communications directed to specific targeted populations with particular messages about completed research or development. The distribution of information serves a variety of purposes. Information about research completed and underway is essential to others engaged in fundamental studies. The educational developer needs to know the latest findings about learning if he is to be able to incorporate them in his work. Both researchers and school people need to know what development efforts are underway. The problems encountered by those in curriculum

or hardware development often suggest research projects to psychologists or sociologists. Finally, the existence of a dissemination capability itself needs to be widely publicized to insure that all those having the need can make appropriate use of it.

A fourth and final function is the training of personnel to carry out the various functions conceived to be part of the research process. In the United States authority to train researchers and research related personnel is built into the legislation authorizing the research activities.*

The Resources for Research

What are the resources available for planning, supporting, performing, and evaluating research in education, where are they located, and how are they organized?

In the United States the financial resources come largely from the Federal government. They are of relatively recent vintage. In 1957 the Congress of the United States made the first appropriation under the Cooperative Research Act to support research, surveys, and demonstrations in education. There are now, however, a total of seven pieces of federal legislation authorizing research in different aspects of education. In addition to the Cooperative Research Act they include authority for research on new media and modern foreign languages, vocational education

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* One point of considerable interest is the ways in which the various component functions in educational research relate to one another and the operating educational system. One current model of how research and development relate to change in education is briefly described and an alternative to it developed by one of the present authors in Appendix A of this paper.

research, handicapped children and youth, libraries and information science, captioned films for the deaf, and a special authorization to use certain non-convertible foreign currencies obtained through the sale and distribution of surplus foods.

A variety of activities are conducted by other Federal agencies which relate closely to education research. The National Science Foundation supports curriculum development efforts for elementary, secondary, and under-graduate education. The National Institute of Mental Health and the National Institute of Child Health and Human Development support considerable amounts of research relating to human learning and motivation. The Office of Economic Opportunity as part of its responsibilities in the War on Poverty supports curriculum development and research and evaluation relating to such programs as Headstart and Job Corp, two of the best publicized efforts to attack the cycle of poverty through education. Finally, other activities within the Office of Education such as Title III of the Elementary and Secondary Education Act of 1965 have supported development and demonstration activities.

We estimate that the federal resources available for research and development in education as we have defined it above total approximately $220 million for fiscal year 1967 (see Table I).

Table I. Estimated Federal Support of Research and Development in Education, Fiscal Year 1967

Agency	Millions of Dollars
U.S. Office of Education	
Bureau of Research	99.1
Title III*	81.0
NSF Course Content Improvement	17.0
Office of Economic Opportunity	14.0
NIMH and NICHD	9.1
TOTAL	220.2

* This estimate is based on the assumption that the 1966 proportion (60%) of the Title III, ESEA, activities going to development and demonstration holds for 1967. The analysis of the FY 1967 projects is not yet available, and we have consequently not been able to ascertain if the percentage still holds or if the terms are used as rigorously as we have applied them in this paper.

There are other sources of support for research in education. Private foundations, for example, such as Ford, Carnegie, Sloan, Kettering, Russell Sage and others finance educational research activities. Specific estimates of the total amounts available from these resources are hard to make, but the amounts are in the millions of dollars annually. There are no current figures available regarding the amount of money expended by state or local educational agencies for research. An analysis by John Bean in 1965 reported the total identifiable appropriation for research at the state level in the amount of 3.5 million dollars.* The total amount of support from these sources is relatively small and most of it is spent on surveys or data collection rather than on experimental research or development. Private industry in the United States is also spending several million dollars of corporate funds on educational research and development. (We have made no attempt to estimate the amount of research and development closely related to the training functions of the Department of Defense.)

The discussion above has concerned itself with the financial resources for research. The location of manpower resources is somewhat more complicated. The identification of manpower rests in part on the kinds of functions being supported as part of the total research program, the demands of the research management process, and the characteristics of the educational system (which is often at one and the same time the object of the research and the instrumentality for carrying it out).

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* John Bean, Research in State Departments of Education, (U.S. Government Printing Office, Washington, D.C.: 1965), p.21.

The involvement of the scientific community, largely but not exclusively resident in colleges and universities, is clearly central. The bulk of the fundamental studies must be done by them. In addition, they have a major role to play as participants in development. Schools, colleges, and universities have important roles to play in development and demonstration, particularly since it is the professional roles within those institutions which will be changed by the development efforts. New institutions have been established to engage in development such as the regional educational laboratories (to be discussed in more detail later) and, together with established organizations such as state agencies, the Educational Resources Information Center, and professional associations, they have important dissemination roles to play as well. Private industry has strong competence in the field of development and dissemination and thus has a contribution of importance to make here. Finally, there is a broad range of non-profit institutions other than governmental agencies and schools of all kinds which have talents and capabilities to contribute to the research program.

The Management of Research

With a brief discussion of the nature of research and an idea of what the resources available for research might be, it becomes possible to discuss more meaningfully the problem of managing the entire research process.

The first question it is useful to explore is why it should be necessary to manage the research effort at all. The principal reason for managing the research effort is the reason for managing anything: to achieve the objective set for the program with the minimum expenditure

of money and manpower. Procedures are required to allocate limited resources among the research, development, dissemination, and training functions. Management is required to achieve stability of effort over time. It insures that planning takes into consideration all the possible areas of priority that various groups, public, professional, and technical may express. Management is necessary to establish priorities among the substantive research and development activities. It is required to identify, recruit, and maintain manpower to perform the necessary activities required to sustain a large research effort. Each of these requirements will be discussed individually.

The need to allocate funds among the several functions of research, development, and dissemination, and training arises from two factors: (1) the equally high priority of performing each; and (2) the significant variance in their relative cost. If each of the functions must be supported in order for the research program to have beneficial impact on the educational system, then the necessary funds in proper proportion must be reserved for each.

A second reason for management is to insure stability of effort over time. The need exists both in terms of supporting the various research functions and the specific activities in substantive areas. Effective research management makes it possible to keep working in an area which may be unpopular, or to see to it that a development project is pressed as hard as it can be without sacrificing quality. It is required to insure that long range needs are served in just proportion along with short and medium range research and development requirements.

A third reason for careful management of a total research effort is to insure that all groups expressing research and development needs are heard from. In addition, extra efforts need to be made to identify possible research and development requirements which are not being recognized and therefore, having no spokesman, are not being served. The requirement for careful needs identification and assessment stems from the certain fact that resources will never be adequate to serve all the priorities which may be identified. Since only a few can be chosen it is important that substantial efforts be made to insure that competition among all the priorities is equitably fostered.

That leads directly into the fourth reason for managing research, establishing the priorities among the many activities which might be supported. It is in many ways the most important, the most controversal, and the most difficult to do. The fact is that there are never enough resources, either financial or human, to undertake all the activities that might be desired. Choices must be made. Those choices should be made in the light of an explication of all possible courses of action and a full assessment of the needs of the educational system as a whole.

Finally, the fifth reason for managing research is the need for identifying, recruiting (and training if necessary), and then supporting the manpower necessary to perform the various research functions. This requirement is closely related to the last in that generating research planning inputs is in part hunting for talent. But it is also different in that it is the manpower planning process applied now to the special area of research in education. Finally, it is not just a matter of

finding, recruiting, or training manpower but judging that they are in the right kinds of organizational settings to be able to fully utilize their talents.

What specifically does management mean? How do the reasons for managing research affect the procedures which are adopted? Extrapolating directly from the reasons for management developed above, managing research means:

1) establishing priorities among functions and substantive activities,

2) implementing programs and projects including identifying or creating resources to carry them out,

3) developing feedback and evaluation for purposes of program redirection,

4) developing and sustaining a communications network to insure adequate information flow, and

5) evaluating the impact of research on the educational system.

When discussing management, however, there are different levels of abstraction. It is possible to speak of the total research effort, of programs, and of individual projects. What is meant by the total research effort is relatively clear. A program, on the other hand, refers to a long-term self-adjusting effort to investigate an area of concern or to perform a certain function in an ongoing manner. A project is a more definitely time-defined activity that has a specific outcome as its objective, either a finding or a "product" of some kind. Programs are usually made up of projects although not all projects need necessarily be part of programs.

According to these definitions, defining and choosing the programs which may be included in the total research effort is quite clearly up to those responsible for that total effort. Choosing individual projects, however, can in a sense be delegated (when a program is established, for example) or responsibility can be retained by those responsible for the total research effort.

Besides different levels of abstraction for management keyed to the scale of effort, it is also clear that the type of function supported is likely to demand quite distinct techniques of management. The differences between research and development, for example, suggest that special management techniques may be appropriate for each. Those differences may even be important enough to suggest different institutions as sponsors for those functions. Thus the decision to support given programs and projects depends in part on a judgment on whether or not particular agencies, institutions, or organizations are capable of managing or hosting particular types of activities. The characteristics of certain kinds of research, for example, suggest that universities or university based organizations may be the most appropriate place for these activities to be sponsored and managed. The nature of development may very well demand a quite different environment such as private industry or, as in the United States, a special kind of organization created to carry out this new function for education. (The actual management of research or research and development organizations is a matter which has been the subject of

papers in their own right and will not be discussed further here.*)

Two further features of the management of research need mention. The first is the development and maintainence of a communication network which serves two purposes. The first purpose is to insure an adequate flow of information for dissemination. It is important that individuals responsible for research and development are continually made aware of projects completed or underway. The second purpose, to serve the needs of program development, is related to the first. Adequate information flow is essential to good research planning and to the performance of the other management tasks for research. If the individuals responsible for the research effort cannot themselves be kept informed of findings and needs, the program development responsibiltieis which they bear are severely compromised.

Finally, research management has a critical role to play in the identification of appropriate kinds of technical expertise to evaluate proposals and projects prior to support, and to assess their value upon completion. Insuring an adequate supply of such expertise is absolutely essential if research managers are to have the best advice when developing analyses of research priorities and when actually monitoring research activities. Scientific competence is not, however, the only kind of expertise which should be made to flow into the policy councils of the research program. It is equally necessary, particularly in regard to the

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* See for example Organization for Research, Phi Delta Kappa and The American Educational Research Association, 1966.

development responsibilities of the research program, that the flow of the best advice from school personnel, educational administrators, and the lay public (including political leadership) be secured to an equally great degree.

Technical competence, of course, is not the only way in which the activities of the research program may be evaluated. When research finds its way into development and is then operationally validated by the successful application of those development efforts, the research has received a kind of evaluation which in the long run is the most important it will get. Similarly, the rate of adoption of the products of development testified to the adequacy with which they have been geared to real needs or desires on the part of school personnel.

Both of these forms of evaluation are longer range. It is also possible to apply short range criteria and employ appropriate technical expertise to assess quality. Many types of competencies are desirable as inputs to the planning process, and the identification of technical competence for monitoring actual activities must be found in as broad a range of personnel and institutions. The evaluation of proposals and project activities in basic research must rely heavily on the scientific community. A curriculum development proposal or project, however, producing reading instructional materials for urban core disadvantaged youngsters, for example, requires the expertise of a sociologist, a learning psychologist, and a linguist, to be sure, but it must also make use of the advice of practitioners who will be potential users of the materials and be able to call upon the wisdom of the managers of development who can assess the degree to which the project is meeting its

objectives within the time, money, and manpower constraints which necessarily exist in any effort of that kind.

II

THE EMERGENT UNITED STATES STRATEGY FOR RESEARCH

Any discussion of education research based on the experience of the United States necessarily takes place within the context of the American educational system as it has emerged. Responsibility for education, for example, rests with the individual states on the basis of tradition and Article 10 of the United States Constitution (which reserved to the states all those powers not expressly delegated to the Federal government). Local educational agencies or school districts are principally responsible for the actual operation of schools. Finally, the Federal government performs an increasingly important role particularly in connection with new and significantly expanded programs of financial support.

While responsibility for education has been vested in the states and then delegated to some 25,000 school districts, and while the role of the Federal government has largely to this date been confined to providing specified categorical financial support, there are still other features, certainly not uniquely characteristic of American education, which complicate the operation of the total system beyond the simple layering of responsibility.

For example, not very many of the diverse institutions and agencies which serve education in the United States are well coordinated or formally related to one another. We have a <u>de facto</u> system, to be sure, and this

"system" seems to have served the broad needs of the society fairly well. However, it might serve them better if it were generously laced with efficient communication channels designed to help make it an integrated, functionally related entity of many parts and purposes despite the many different points of primary jurisdiction and control. It probably makes most sense to talk of the American educational system as a collection of classes of institutions and agencies the relationships among which are sometimes more and sometimes less well attended to. The classes of institutions include the three levels of responsibility for education (local, state, and federal), professional associations, institutions for training teachers, the industries which supply materials and equipment to the schools, and the universities, institutes, and non-profit organizations under whose aegis research on learning and education is performed.

One of the principal objectives of the Office of Education is to provide the means by which the American educational system can undergo continuing qualitative improvement. The foundation for any kind of improvement is knowledge and its systematic implementation in operational settings. The central purposes of the U.S. Office of Education research program are (1) the generation of knowledge about learning in education, (2) the development of validated economically feasible alternative* instructional "products" (i.e., materials, techniques, equipment, processes,

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* The necessity to produce alternative materials and techniques arises directly from the multiple points of primary jurisdiction and control in American education. In order to both preserve and enhance the implementation of State and local responsibility for education, the Federal role must be one which <u>creates</u> powerful alternative courses of action rather than limits them. In any given area of curriculum, for example, there is no single "best" course. To develop only one, even if it is far superior to anything else in existence, is to limit choice in a sense, and is therefore to be carefully guarded against.

organization forms, and so on) for adoption at local choice and initiative, and (3) the dissemination of information that will enable local schools to be aware of and implement the new techniques.

Research Strategies of the Past

The availability of millions of dollars for educational research and development is a relatively new phenomenon in the United States. The recency of this growth and its absolute size give some pause for thought. A review of developments to the present helps disclose the range of options available to us now and in the future.

The several pieces of legislation specifically authorizing the United States Office of Education to support research in education have been quickly reviewed already. The major one, the Cooperative Research Act, was passed by the 83rd Congress in 1954. The act itself represented only a first step in the development of a national strategy for research and development for education.

The passage and funding of Federal legislation authorizing research in education was a major departure in itself, reflecting recognition that Federal support needed to be directed to problems which transcended State boundaries and resources. The initial efforts in support of educational research combined the general identification of areas of concern (for example, motivation, environmental factors in learning, or English curriculum) and the support of technically excellect proposals submitted in response to a general call. The very first proposals under Cooperative Research, for example, were stimulated for research dealing with mental retardation. As the research program expanded in dollar size, however,

greater proportions were administered on a non-priority basis. Areas of importance were identified periodically and proposals funded in those areas, but the guiding principle for the support of research was the technical excellence of the proposals rather than the type of research or the substantive area of concern. That principle was viable, because in the early days of the research effort there were sufficient funds to support all the technically excellent proposals without regard to the field of study.

The beginning years of the program were clearly geared to the stimulation and growth of research activity. Competition for support of proposals grew increasingly keen, but the prospects for funding were still exceedingly good. These policies of research management were successful in producing increased interest in education research and in drawing significant amounts of new talent into the competition for research funds.

Over the years substantial amounts of basic and applied research were stimulated and supported. In more recent years the research program moved into two new kinds of activity, the support of curriculum improvement and university based research and development centers. The curriculum improvement projects were relatively small scale, conservative efforts primarily to revise the content of courses in the social sciences, English and the language arts in keeping with the advances of current scholarships. The intent was also to organize the improved content into more carefully prepared sequences of presentation in order to improve the pedagogy. The Research and Development Centers were established and supported at $500,000 or more a year in order to create organizations with a strong university base capable of administering a programmatic research and development effort in a defined problem area relating to education. Centers are

expected to conduct research in that problem area and pursue the implications of the findings of their research through to a development phase and pilot trial in a school system.

Even with the addition of these two new thrusts to the research program, the same principles of non-solicitation and the support of technical excellence prevailed. The programs were announced and proposals funded accordingly, but no formal attempts were made to solicit particular activities according to a plan developed in advance. In summary, the research field for education was still young and growing and funds were generally sufficient to support all the proposals judged technically excellent by the experts who reviewed them.

Strategies of the Recent Past and Present

In 1964 several groups including staff inside the U.S. Office of Education and a Presidential Task Force began to take a hard look at federally supported research in education, then nearly 8 years old. The wisdom of earlier strategies was apparent. They had been successful--in part because of the availability of dollars, in part because of the generally unsolicited mode of operation--in stimulating the growth of an interest in research and development. The field was growing; the rate of proposal submission was increasing very quickly (in fact, at a faster rate than appropriations). The educational community as a whole was beginning to pay attention to the possibilities of research.

The increased visibility of research and development, however, led to concern over some of the deficiencies of the research effort as it had emerged to that point. First, it became apparent that the individual research projects, while of acceptable levels of quality individually, did

not fit together well enough to be considered coordinated approaches to substantive problems in education. The Research and Development Centers program had in part been created in response to this need, but it was still felt that major portions of the project research effort could be better coordinated and better designed to lead to cumulative rather than fragmentary results.

Second, part of the difficulty in developing highly coordinated, cumulative research efforts could be attributed to the inadequacy of the dissemination of information to the educational research community. This deficiency included the lack of information about both the findings of completed research and the nature of current research. A need was identified, in short, for the establishment of an effective research dissemination system.

Third, a review of the impact of research as measured by changes in school practice revealed that insufficient attention was being paid to the transition from research to school operations. On the one hand, the stage of development was not being supported to anything near the degree which it should. On the other, very little attention was being directed to the processes by which improvements could actually be implemented in widespread fashion.

Fourth, it was clear that the human resources available for research and development activities would need to be expanded. There were at least two ways in which this could be accomplished. Training programs to develop new talent could be established, and agencies and institutions previously not permitted to apply for support could be made eligible.

The response to these identified needs took the form of new legislation in 1965 and the development of programs based on the new authority. The Cooperative Research Act was amended by Title IV of the Elementary and Secondary Education Act. The amendments broadened the existing authority (to support research, surveys, and demonstration) to include dissemination. The range of eligible institutions was expanded to virtually all kinds of public and private organizations whether profit or non-profit. Authority was included to develop programs designed to train educational research and related personnel. Finally, the U.S. Commissioner of Education was given authority to award funds for the construction and equipping facilities for research and related purposes.

These amendments vastly extended the range of activities possible under the research program, and made it possible to meet directly the needs identified in the reviews of the program to that time. The testimony before the Congressional committees prior to the passage of the amendments made it very clear that the purpose was to bridge the gap between research and practice and to pay substantially more attention to the problems of implementing the knowledge derived from the research efforts of the past and the future. The broadened responsibilities created by these additional authorizations placed new demands on the administration of research, but it also offered new tools for meeting emergent shortcomings of the research effort.

Three major new program thrusts are undergoing spirited development as a result of the amendments. First, a training program designed to expand the core of educational researchers has been developed to provide program development grants and an array of training mechanisms for educational researchers. These range from institutes through undergraduate and graduate training programs to a small post-doctoral fellowship program.

Second, the Educational Resources Information Center (ERIC) has been established with central ERIC and 18 clearinghouses. ERIC is designed to provide to researchers and practitioners alike an information storage and retrieval mechanism making available at an instant in easily accessible indexed form all the research and related data relevant to particular problems in education. Research in Education, the monthly publication of the ERIC system, is now in its eleventh issue. Already the usefulness of this effort has begun to prove itself.

The third and largest development in the research program, the National Program of Educational Laboratories, has awakened the interest, excitement, and the enthusiasm of the entire educational community from local schools, State agencies, and teacher training institutions to industries, scholars from the arts and sciences, and the lay public. Drawing from resources in regions extending across the nation new institutions called educational laboratories have been created to bridge the gap between research and practice. The institutions were created by representatives of the many agencies and institutions which play different roles in implementing the knowledge derived from research. The laboratories are

reflections of the conviction that is is not enough to do research, but that development efforts must be initiated, completed, and then carefully installed in operational settings before significant, far reaching improvements in instruction will occur.

The laboratories have therefore also been charged with the responsibility for active dissemination campaigns based on the successful development projects they and others engage in. The labs have been encouraged to conceive this responsibility broadly, encompassing much more that the mere distribution of information. Clearly, for example, one of the important steps in the diffusion of research based improvement is the establishment of demonstrations. First time or pilot demonstrations of feasibility will be the direct responsibility of the laboratories; the more widespread diffusion of the successful innovations will depend on the degree to which fnformation about the innovation is distributed to various parts of the systems, the degree to which the innovation recommends itself to professionals, and the degree to which credible demonstrations of the new practice of curriculum are mounted in schools. This last part of the diffusion process, the establishment of real life demonstrations of the innovation without the intervention of the original inventor, is a vitally important part of the diffusion process and is a function in which the labs can be expected to become heavily involved in a supporting role.

The laboratories were conceived in such a way as to involve in their government and their operation the many types of different responsibilities and resources that combine to form the educational system as we know it. These new institutions; operating programmatically and knit closely together to form a national network, will, as their resources permit, engage in (1) major efforts to develop new materials, practices, and organizations using the outcomes of research and (2) using the expertise brought to them by the involvement of different agencies and institutions, pursue courses of action which help hasten the process of improvement once tested innovations are available.

The logic behind these three new pieces of the research program is straightforward. If there is to be an expansion in research and development, people will need to be trained or recruited from new areas to fill the demand. Dissemination networks and the material which moves through them will need to be both improved and better systematized. Finally, to help fill the gap between research and practice a new autonomous institution drawing institutionally and representationally on many resources in the educational system was created to assume responsibility for development.

In addition to the amended authorizations for research, the 89th Congress also passed Title III of ESEA. This program, authorizing support for projects on application by local educational agencies designed to supplement existing school programs and to serve as models for existing school programs, was an innovation in itself. When then

Commissioner Keppel testified before the House Sub-Committee on the Elementary and Secondary Bill he told the Congressmen that he viewed Title III and the research amendments together. The amended research authority was to be the means whereby the substance of educational improvement would receive increased impetus and attention; Title III would be the means by which local schools could initiate the kind of credible real-life demonstrations which, by being convincing to their counterparts, could become one of the moving forces for the widespread adoption of tested innovation. Those responsible for Title III estimate that in fiscal year 1966 fully 60% of the money went to support projects relating to the functions of development and demonstration. In FY 1967 the program expected to do at least as well. Most important, for the first time local educational agencies were provided the funds and the encouragement to experiment with new ideas.

Current Emphases for the Research Program

The educational laboratory, training, and dissemination programs under development will be supplemented by a number of activities arising out of the current planning. These newly emerging program components together with a substantial improvement in the planning process itself will contribute to the further evolution of the total research effort.

The Improvement of Planning as a Pre-Condition for Progress

Four activities can cited as part of the attempt to improve planning within the research program. The first of these is closely associated with the evolving analysis of the research effort and how the various parts of the research program relate to one another. It is quite clear that greatly increased efforts must be made to secure statements of need and advice from broader segments of the research community, the education community, and leading public citizens.

The research program has always sought the advice of scientists, educators, and scholars in reviewing and evaluating research proposals. Through the mechanism of a twelve member Research Advisory Council, advice is secured on matters of policy affecting the program. If, however, the program is to take on even greater responsibility for specifying and focusing the activities which it supports, it will have to pay much more attention to seeking the advice and counsel of all those groups--professional, scientific, and the responsible public--who are in a position to have reflected upon problem areas in education or instruction which need research or development.

The encouragement of the contribution of many different groups to the raw material of the planning process is not as simple a task as it might seem at first glance. Care must be taken to assess the bases for recommendations and opinion depending upon what part of the entire program is under consideration. Some groups, for example, are much more qualified to offer advice for certain parts of the program than others. The scientific community, for example, has a great deal to contribute when it comes to planning the program for fundamental studies. When it comes to planning development activities, however, their contributions, while important, may be no more so than those of public officials, school administrators, and teachers, for here their proposals must be weighed against quite different criteria, including, for example, the social and political purposes for education. In establishing objectives for development then the lay public and its representatives have as much to contribute as the academic community, and means must be found, therefore, for securing that contribution.

A second major activity to guide planning which needs to be supported much more extensively than in the past is the kind of study exemplified by the Equal Educational Opportunities Survey (Coleman report), Project Talent, the kinds of surveys completed as part of the Plowden Report, and the recent International Mathematics Study completed under the direction of Torsten Husen. These studies are an essential part of the data base for policy development in education and therefore also for educational research. They can provide evidence for the gradual progress of education, the effectiveness of changes of various kinds in the system as a whole, and, because of the development

of sampling theory, can at the same time preserve the anonymity of individuals and schools if it is desirable to do so.

A third new activity useful for planning for which we have just begun pilot support is the study of alternative futures for education. Educators are well aware of the substantial lead times involved in calculating the effect of their programs on the society at large. Research administrators are just as aware of the long lead time required from the identification of a research finding on learning to its implementation in instructional practice.

Observers of social change have noted how Western culture appears to be in a state of increasing flux. For educators this suggests that if society is in fact to be quite different in 20 or 30 years, the schools must presumably change at least proportionately as much and perhaps more so. What alternative possibilities are there to express the relation of the school to society by 1985? What might the objectives for the school be, and how will that represent a change from today? What kinds of technologies, hardware and human, are likely to be available for instruction? What will the financial and human resources for the schools be? These are all questions which need examination if the development activities supported under the research program are to relate well to the futures which the culture desires for itself and which the schools can help contribute to or, at least, be responsive to when the time comes. This essential ingredient to the research planning process (and indeed to the education process as a whole) will be provided through the support of centers for the study of educational policy which will examine in an interdisplinary

systems-oriented manner the four questions developed above.

A fourth element, government wide in its impact, that will contribute to the improvement of the planning process in research is the introduction of planning-programming-budgeting techniques. Such techniques require that all programs be described in terms of both input and output measures. By carefully developing descriptive terms for activities, target groups, and outputs it becomes possible to develop a thoroughgoing data base for describing individual programs and program elements. By then requiring the development of program plans in terms of alternative allocations of funds among competing program elements, it provides program managers at all levels with the tools for making more rational decisions. Such techniques are difficult to apply to research programs, but they do force the research administrator to look much more carefully at his programs in terms of alternative allocations and to ask much more searching questions about the total impact of the decisions he is being called upon to make.'

Fundamental Studies

Examination of the present program of education research in the United States has revealed the small extent to which significant fundamental research has been supported under its auspices and the rather large extent to which the program has been composed of non-development-related applied research. The consequence of this occurrence has been a relatively low impact on the schools and the slow development of a body of research findings on which both further fundamental study and development efforts can be mounted.

It is necessary, therefore, for us to continue to expand the areas in which we are supporting fundamental studies and to direct our concern more diligently to specific areas of study to which we have paid some, though perhaps inadequate, attention. An example of the latter case is environmental factors and their effect upon learning. The major surveys which have recently been completed or on which we have interim reports all emphasize the importance of the non-instructional socio-economic status and environmental variables in predicting success and achievement. We need to know much more about the specific nature of these interactions if we are to make effective use of them (or act to counter them) in instruction. An example of an area in which we have done virtually nothing under education research auspices (though other agencies have supported activities here) centers on the effects of drugs on learning. Recent research on senility and aging as well as experiments involving RNA and the nature of memory suggest that an area of high interest long-term payoff for basic research is the chemistry and biology of learning. These are only two examples; others could be given, but they do illustrate the kinds of expansion of scope and scale that are called for in the future.

A second aspect of the expansion of fundamental studies is the continued effort to recruit scholars and scientists from the academic disciplines to undertake studies relating to education. Furthermore, it seems clear that we need to adopt a deliberate strategy in supporting fundamental studies of finding talent and then systematically supporting

it, either individually or institutionally, on a long term basis being patient enough to wait perhaps years for the outcomes. Not all basic research has this character, but a substantial part of it does. The manager of research should be willing to support those activities which bear "the promise of relevance" to education and learning, but which clearly have no immediate application.

To accomplish these ends, it will be necessary to resist the demand to support the isolated applied research projects which have tended to dominate education research programs of the past. It will mean that a close and continuing interchange with the scientific community needs to take place to identify the areas and lines of study of greatest potential significance, to enlist the talents and capabilities of the strongest individuals and institutions to conduct research programs in those areas, and to evaluate, critique, and draw implications from the studies which are supported.

Development

A major portion of our research strategy is the expansion of development. It is expected that development will ultimately be supported in a number of different ways.

The educational laboratories constitute one of the principal mechanisms. Several features recommend them as good vehicles for carrying out development. They were created with the object of being interdisciplinary organizations. Their governing boards reflect the variety of different kinds of institutions involved in the educational system and the encouragement of change. They are, therefore, likely to be live repositories of feelings of need and desire with regard to

specific kinds of improvements in instruction for which development is a necessary antecedent. Third, being representative of different institutions in their region, they are in a position to enlist and draw on the best talent to accomplish the development and diffusion responsibilities. Fourth, their close relationship to a region gives them a proximity to schools which is essential for both the actual development process and the diffusion of proven innovations into the schools.

The laboratories have been in existence for just 20 months. Under the chairmanship of Dr. Francis Chase the Advisory Committee on the Educational Laboratories, a body set up by Secretary John Gardner (HEW) to offer policy advice to the U.S. Commissioner of Education, has recently completed an examination of the infant program. A policy statement issued by them upon completion of their review stated that they were impressed, despite the short duration of the program, with the achievements of a number of specific labs and the momentum of the program as a whole. They affirmed their confidence in the concept of the laboratory program while at the same time recognizing that organizational and planning work was still necessary. Perhaps most importantly, they called "earnestly" for more resources so that the labs could move rapidly beyond the planning stages to action and implementation. The continuing cultivation and strengthening of the laboratories constitutes one of the cornerstones of current policy.

Other examples of development exist, however, in the activities of the Research and Development Centers and the support of the curriculum commissions of the National Science Foundation. An example of the

former is the curriculum work supported under the auspices of the Pittsburgh Learning Research and Development Center toward the development of Individually Prescribed Instruction. This effort, now being carried forward through its field trial stages by the educational laboratory head quartered in Philadelphia, is designed to create a curricular system where each child proceeds at his own pace under the guidance of teachers who prescribe lessons for him on the basis of information gathered from a continuing series of diagnostic measures.

The work of the curriculum commissions supported by the National Science Foundation in mathematics, the natural sciences, and some of the social sciences is well known all over the world. Such major curriculum development efforts as the School Mathematics Study Group (SMSG), the Biological Science Curriculum Study (BSCS), the Physical Science Study Committee (PSSC), and other groups have been actively engaged in updating the content and methodology of mathematics and science instruction for ten years. These curriculum development efforts of NSF will continue.

In addition to the above activities the Office of Education has recently initiated a number of projects which exemplify an additional technique for supporting development. Recently a request for proposals (RFP) was issued to study the design of a centralized computer facility to serve 50 institutions of secondary and post-secondary education (in the latter case not including 4-year colleges and universities) within a hundred mile radius and with a combined enrollment of 100,000 students. The purposes of such a proposed facility would be to teach students about computers and programming, to serve as a computational tool in

course work, and to perform necessary administrative tasks for the cooperating institutions. The RFP stimulated 38 proposals of which two were funded. This method of funding development activities--putting out an RFP for a design study and then, if the design studies are successful, releasing a new RFP for a pilot project--is a management technique which will be utilized much more extensively in the future.

The RFP technique of solicitation will also be used in connection with one particular kind of development effort which promises to have significant impact on education. Recently, in connection with a program analysis effort associated with future legislative planning, a review of a number of major research studies in education was conducted. When the immediate requirements of the review were met, the task force conducting the review turned its attention to the studies themselves, exploring what turned out to be the relatively low power of the studies, major though they were, for offering clues useful in the discussion of policy. The participants of the review effort were impressed by the large number of variables that the surveys had attempted to account for, and, on the other hand, the relatively small number of variables that recent experimental research had attempted to cope with in a meticulous way. The more the issue was explored, the more it impressed the participants that the smallest aggregate of instructional variables that seemed to make sense in terms of attempting significant departures in educational innovation might very well be an entire school. One of the recommendations of the group, consequently, was that not only should the general effort in education research and development be dramatically increased and the level of sophistication

elevated, but also the scale of individual program efforts should be raised to that of entire institutions.

During fiscal year 1968 it is hoped that several such projects can be begun. An example of one currently under consideration is the development of an entire teacher education program for elementary and pre-school teachers. If such an effort were to be undertaken it would most probably begin with a design study phase during which a number of projects would be supported each independently developing a conceptual design. The individual projects would then be evaluated and two or three of the best would be picked as models against which major teacher training institutions in conjunction with a cooperating agency with development capabilities (such as private industry or a regional laboratory) would make application. Depending upon the availability of funds, one or two of these efforts would be supported. The federal contribution would be directed to the curriculum and other development costs associated with the effort.

What is new about this approach to an educational problem is the effort to design a totally new instructional process and procedure. The design studies must specify, in, for example, the instance cited above, what the objectives of the teacher education program are in terms of the terminal behaviors of the participants, must then map out conceptually a curriculum sequence to meet those objectives, and begin to develop a program for accomplishing implementation of the design through the initiation and completion of an integrated set of research and development activities. Such an effort may take from five to seven years to complete and cost between $20 and $40 million.

The benefits to be obtained from such an investment are an order-of-magnitude advance in teacher education and in the capabilities of professional personnel charge with instruction in the elementary setting.

Personnel Development

The research training program is now well into its second year of supporting doctoral candidates in research training programs in education and in academic disciplines most appropriate for research for education. This program will need to expand still further to insure a continuing flow of researchers to work on the problems of education.

At the same time, however, it will be necessary to create, staff, and support programs oriented to the training of the people who will engage in curriculum and other forms of educational development. Most of the manpower now familar with this kind of activity has been trained on the job. This is both time consuming and costly. These kinds of people, whom Robert Glaser has called educational engineers and whom we have called behavioral engineers, will need to be produced in considerable quantity through undergraduate and masters degree programs. Curricula will need to be developed for these programs and professional departments of instruction will need to be created. It is anticipated, therefore, that in the years ahead (hopefully, beginning this year) program development and curriculum development grants associated directly with training these kinds of development specialists will be awarded to appropriate institutions in the United States.

Other plans for personnel development include paying more attention to the development of research competence in research-small institutions (those without much research activity) and the enhancement of research

capability in research strong institutions by rewarding them with institutional grants which they may use at their own discretion for developing their research capabilities still further.

The rationale behind supporting research activities at research-small institutions is principally associated with later efforts to disseminate the results of research and development in education. Large numbers of teachers are currently being trained in institutions where little or no education research is taking place. We believe that it is important for the instructional staff in such institutions and particularly for the undergraduates to have some contact with research on learning as a way of initiating them into an expectation of future changes and an understanding of what the relation of research to education is or can be.

Dissemination

The last area in which new techniques will be brought to bear to accomplish the ends of the research program is dissemination. The full development of the Educational Resources Information Center is a primary thrust. It is important, however, that the dissemination activities also encompass a variety of active programs as a complement to the essentially passive ERIC system. The principal effort in an active dissemination campaign will be the support of a program of targeted communications. Each communication, whether a film, tape, slide program, game, simulation, or print document, will be designed to carry a specific message about research or development to a specific audience. Sets of messages centering on a particular finding or

instructional technique can be prepared, each oriented to a particular group which might conceivable have some role to play in applying the finding or implementing the technique.

The kinds of dissemination techniques which might be employed in such a program are numerous and over time we expect to exploit them all. Mass dissemination techniques employing radio or television will certainly have a role to play, but so will small group approaches for superintendents, principals, legislators, or school board members.

The Financial Implications

Each of the sections preceding this one imply greater or lesser increases in the investment in research and development activities. A few words can profitably be said about the general scope of this necessary increase and the distribution of funds among the several activities. One cautionary word, however. It is important to be reminded that highest priority does not always mean "largest amount of money." Several activities can be of equally high priority and yet, because each costs substantially more or less than another, receive allocations of considerable variance. All of the functions identified above are critically important to a large, well-balanced research and development effort for education. The amounts of money ultimately to be allocated to each, while a relevant matter, are also a direct function of the costs associated with research.

Our rough analysis of the cost associated with research, development, training, and dissemination suggests that a <u>minimum</u> figure of total investment for these functions is one percent of the total annual operations expenditures for formal instruction in the nation.

For the United States this would approach one half billion dollars annually. This estimate is based primarily on the cost of curriculum development in which we have some experience and for which we are beginning to be able to arrive at some fairly stable cost figures. Thus, it seems reasonable that (1) with a large number of curriculum areas for which materials might be produced at different levels of sophistication and for different levels of instruction, (2) the regular need for re-building materials every 5 or 7 years, together with (3) the challenge of designing and developing completely new and integrated systems of instruction for entire schools and (4) the particular American requirement to produce multiple approaches to the curriculum to allow for local choice, $300 to $350 million a year for curriculum and other forms of educational development does not at all seem an unreasonable minimum figure. The remaining $150 to $200 million could then be allocated among fundamental studies, training of researchers, and dissemination activities. A rough estimate of the proportions for these three functions would place support of fundamental studies, training, and dissemination in an 8:4:3 ratio for the funds remaining after investment in the development.

III

CURRENT RESEARCH AND FUTURE EDUCATIONAL POLICY

The introduction to this paper suggested that there are at least three ways in which the decision to support research and development can be discussed as a policy matter. First, should it be supported at all? Second, what specific areas should receive support? Third,

what are the implications of current research activities for major educational policy and planning decisions?

The paper has concentrated heavily on the first question and touched lightly here and there on the second. As for the third question, there are four areas of current research activity which raise very interesting and significant policy questions. These four areas are:

1) studies of human growth and development, particularly those concerned with early childhood;

2) the importance of the social context of the learning process, especially those studies indicating the importance of socio-economic status, peer groups, and parental attitude;

3) the development of individualized instructional techniques and new curriculum development; and

4) the potential impact of communication and computer technology.

Human Growth and Development

A substantial amount of work (Bernstein, Piaget, Hunt, etc.) has been done in the area of early childhood and cognitive growth. Recently Benjamin Bloom reviewed hundreds of longitudinal studies of human growth and development in his volume Stability and Change in Human Characteristics.* These longitudinal studies, examined as a body, reveal the critical importance of the early years for cognitive growth and suggest that the degree of plasticity in human characteristics during this time could, if properly worked with, lead to astonishing consequences including a general elevation

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* Benjamin S. Bloom, Stability and Change in Human Characteristics, (New York: John Wiley & Sons, Inc., 1964).

of human capacities.

What are the social and economic costs of ignoring the apparently tremendous opportunities for enhancing human capabilities by not providing sufficiently enriching environments to stimulate early learning in all individuals? What are the costs of providing such environments? What is the likelihood of developing suitably individualized curricula capable of enhancing the potentialities of all children? What are the economic, social, and educational implications of fully developed one, two and three-year pre-school programs supported at public expense?

Social Factors and Learning

A number of studies completed and underway have stressed the importance of socio-economic variables and learning. Several have pointed to the significance of the peer group and parental attitude as independent factors of considerable apparent importance.

The Equal Educational Opportunity Survey (Coleman Report) investigated the degree to which racial and ethnic minority groups in the United States are afforded equal educational opportunities. The results revealed the overwhelming importance of socio-economic variables as predictors of school achievement and revealed how little of the variance in achievement was in fact accounted for (after controlling for socio-economic status) by the variables educators usually consider to be important such as student-teacher ratio, availability of laboratory and library facilities, teacher training, annual per pupil expenditure, adequate physical facilities, and so on. There was some

evidence that the socio-economic status of a child's peers tended to have little effect on his achievement if that status were lower, but tended to have a positive effect on his achievement if the status were higher.

The Plowden Report contains a survey relating parental attitude to student achievement which dramatically revealed the strength of the impact of parental attitude and the surprising degree to which the effects of parental attitude are independent of socio-economic status.

What are the implications of continuing patterns of unequal achievement in schools which seem to be closely correlated to social and economic inequalities and yet apparently substantially unrelated to the natural abilities of these same children? How can the educational system be modified to correct such inequalities? What are the costs associated with correcting such deficiencies? What are the policy implications for future research?

New Instructional Techniques and New Curricula

A number of research and development activities are directed toward individualising instruction.

An example is individually prescribed instruction. This curricular approach is based on the identification of the discrete skills which are components of larger behaviors such as reading or computational competence. Sequences of self-instructional materials are developed to help students achieve mastery in each of the component skills. The lessons are prepared in such a way that a teacher examining the student's performance can identify specific deficiencies and prescribe explicit

materials or activities for that student to help move him toward mastery of the skill. If the student's performance demonstrates mastery, the teacher prescribes materials which will move the student on. Thus each student moves at his own speed. The rapid learner is not bored by repetitious drill on material he already knows, nor is the slower learner lost in a world of repeated failure.

Assuming that this effort and others like it prove feasible, what would be the likely costs and benefits of orienting the entire educational system in this direction? How would professional and non-professional roles alter? (Clearly, for example, this method of instruction largely eliminates the role of the teacher as information presenter.) Are there economic implications in these altered roles and responsibilities? What are the associated staff training requirements? Since the concept of class hours no longer has significance, what should be the criteria for graduation? What are the implications for facility design and utilization, optimum school size, etc.?

Such individualization of instruction has other very significant implications. If the child is seriously ill for two or three months and returns to school, he can pick up where he left off without any risk of having to lose a complete school year. Children can come in and go out of school at any time without disrupting the process either for themselves or for the school. This capability raises the basic question whether scheduled vacations are now necessary. Would it not be possible to run schools the year around and simply tell parents they can take their students out of school for vacations anytime they wish up to a total of perhaps ten weeks per year? What effect would this

have on the overall economy, both from the standpoint of leveling the peaks of the tourist trade and modifying the vacation pattern of industry?

Another example of curricular innovation with implications for educational policy is a major development effort now beginning under the name of the organic curriculum. It is designed to develop materials and practices which will allow the creation of a comprehensive high school one of whose performance specifications is a zero dropout rate but whose principal accomplishment is operating in a manner which realistically insures that each graduate will leave with the choice of four alternative courses of action: community college; technical institute; immediate employment; or a four year college. If this effort succeeds what are the policy implications for employment manpower pools, for increased costs of instruction beyond high school, and for costs of the installation of such a program (presuming that its operating costs are close to current ones)?

Communication and Computer Technology

The use of television as an instructional technology raises many interesting questions in education. What audiences and for what purposes is educational or instructional television most effective? Would it be possible to reach pre-school children in their homes with instructional television programs? Can we provide continuing education for employed adults in this manner? Can we update professional competence in this way as well as use this medium in formal, full-time instructional programs? What does it cost to develop programming

which effectively accomplishes the objectives set for it? Do student response mechanisms associated with instructional television add to the teaching effectiveness of this medium? How will television affect instruction in the schools (especially in remote areas), affect local choice in curriculum, change the teacher's role, student-teacher ratio, and basic school economics? What are the implications in satellite communications for instructional TV?

The use of computers is being explored in a number of different ways. Experimentation for administrative uses has been underway for some time in the areas of business functions, student records, and scheduling, and facility planning. The computer itself is a subject of study in terms of vocational concerns, as a science in its own right, and in terms of its social impact. It is undergoing extensive experimentation for library storage and retrieval needs. Computers are being used for vocational guidance and for measuring student performance - even on essay examinations. Finally, the uses of the computer in tutorial modes and for gaming and simulation suggest exciting areas of research and development the results of which are bound to have a large impact on schools and instruction. Evidence for this is reinforced by the recent findings of two feasibility studies which suggest that the cost of providing remote computer services to high school and post-secondary institutions for administrative uses, computation uses associated with classwork, and for teaching about computers will cost less than one percent of the total present school budget.. What are the implications for instruction, cost, change in professional role, and therefore educational policy

for the ten, twenty, and thirty year picture?

The policy issues raised as a consequence of research and development in each of the four areas exemplify the third dimension of the discussion of research as a policy matter. The results of educational research and development present new and far reaching problems to the policymaker, but they also greatly increase the range of options which he would otherwise have available to him.

Appendix A

An Output-Oriented Model of Research and Development and Their Relationship to Educational Improvement

Hendrik D. Gideonse

Over the past several months I have spent some time thinking about research and development in education trying to develop a model which would express the different functions within the total research effort, the various sources of initiative for these different kinds of activity, and the relationships among them. My thinking has been in no small measure stimulated by recent debate generated in the United States about the ways in which schools and education are likely to be improved most quickly and with the most substantial cumulative and lasting impact. Typically, the context for the debate is a discussion of the change process in education.

Various models of change have been proposed. One with relatively high currency at the moment places research, development, and dissemination in a linear arrangement beginning on the left with inquiry (research) and proceeding to the right through development, diffusion, and adoption (see Figure I). In proposing the model Egon Guba and David Clark called three caveats to attention. First, they noted that the model was constructed on logical grounds and that it was largely unsupported by empirical research. Second, they pointed out that it

Figure 1. A CLASSIFICATION SCHEMA OF PROCESSES RELATED TO AND NECESSARY FOR CHANGE IN EDUCATION*

	RESEARCH	DEVELOPMENT		DIFFUSION		ADOPTION		
		INVENTION	DESIGN	DISSEMINATION	DEMONSTRATION	TRIAL	INSTALLATION	INSTITUTIONALIZATION
OBJECTIVE	To advance knowledge	To formulate a new solution to an operating problem or to a class of operating problems, i.e., to innovate	To order and to systematize the components of the invented solution; to construct an innovation package for institutional use, i.e., to engineer	To create widespread awareness of the invention among practitioners, i.e., to inform	To afford an opportunity to examine and assess operating qualities of the invention, i.e., to build conviction	To build familiarity with the invention and provide a basis for assessing the quality, value, fit, and utility of the invention in a particular institution, i.e., to test	To fit the characteristics of the invention to the characteristics of the adopting institution, i.e., to operationalize	To assimilate the invention as an integral and accepted component of the system, i.e., to establish
CRITERIA	Validity (internal and external)	Face Validity (appropriateness) --- Estimated Viability --- Impact (relative contribution)	Institutional Feasibility --- Generalizability --- Performance	Intelligibility --- Fidelity --- Pervasiveness --- Impact (extent to which it affects key targets)	Credibility --- Convenience --- Evidential Assessment	Adaptability --- Feasibility --- Action	Effectiveness --- Efficiency ---	Continuity --- Valuation --- Support
RELATION TO CHANGE	Provides basis for invention	Produces the invention	Engineers and packages the invention	Informs about the invention	Builds conviction about the invention	Tries out the invention in the context of a particular situation	Operationalizes the invention for use in a specific institution	Establishes the invention as a part of an ongoing program; converts it to a "non-innovation"

* Egon G. Guba and David L. Clark, An Examination of Potential Change Roles in Education, Airlehouse, Virginia, p. 5.

was not necessary for change to begin at the research or inquiry stage. Third, the model itself was a uni-dimensional analysis of change roles which are, however, influenced by a multi-dimensional range of variables not entirely accommodated by the model's structure.

As a model of the change process, this particular schema is simple and logical. However, those of us who have worked intensely on problems of research policy see some shortcomings. The Guba-Clark model does not emphasize sufficiently within its structure that initiative for action of quite different kinds can take place at any point in the continuum. Despite the second caveat mentioned above and because of its linear nature, the model unwittingly implies that innovations begin with the findings generated by fundamental research.

My purpose in developing an alternative model is to create a heuristic which illustrates the essential differences between research and development activities and shows how the two are - or can be - related to one another and to the operating educational system. Such a model ought to illustrate the different sources of initiative for beginning various activities. It should be able to show or imply the interplay among all the functions in the effort to improve instruction.

The model developed depicts a conception of the nature of research and development and their relationship to the improvement of instruction which asserts that research, development, and school operations are

different kinds of activities with quite different objectives or outputs. It indicates that initiatives for each kind of activity are the results of decisions based on quite different kinds of data and equally different kinds of needs. It implies that while there may be a strong logical flow from the production of knowledge through the development of processes to their installation in operational settings, there may be just as strong a flow backwards as operational problems define development programs, which, in turn, reveal the need for certain basic information and theory.

Figure II expresses the model. Three planes are shown, each symbolizing the different orientation of activities conducted under research, development, and school operations. The model is, of course, an abstraction from reality. In the real world these activities are not neatly separated. The point of separating them is solely to illustrate the essentially different orientation of the three types of activity. For each activity represented in Figure II, the model depicts an initiative leading to an output characteristic of that activity.

The lower plane symbolizes the knowledge orientation of research activities or fundamental studies. The object of research is to generate new knowledge. One of the significant features of research is that when activities are begun the specific outcomes are not known.

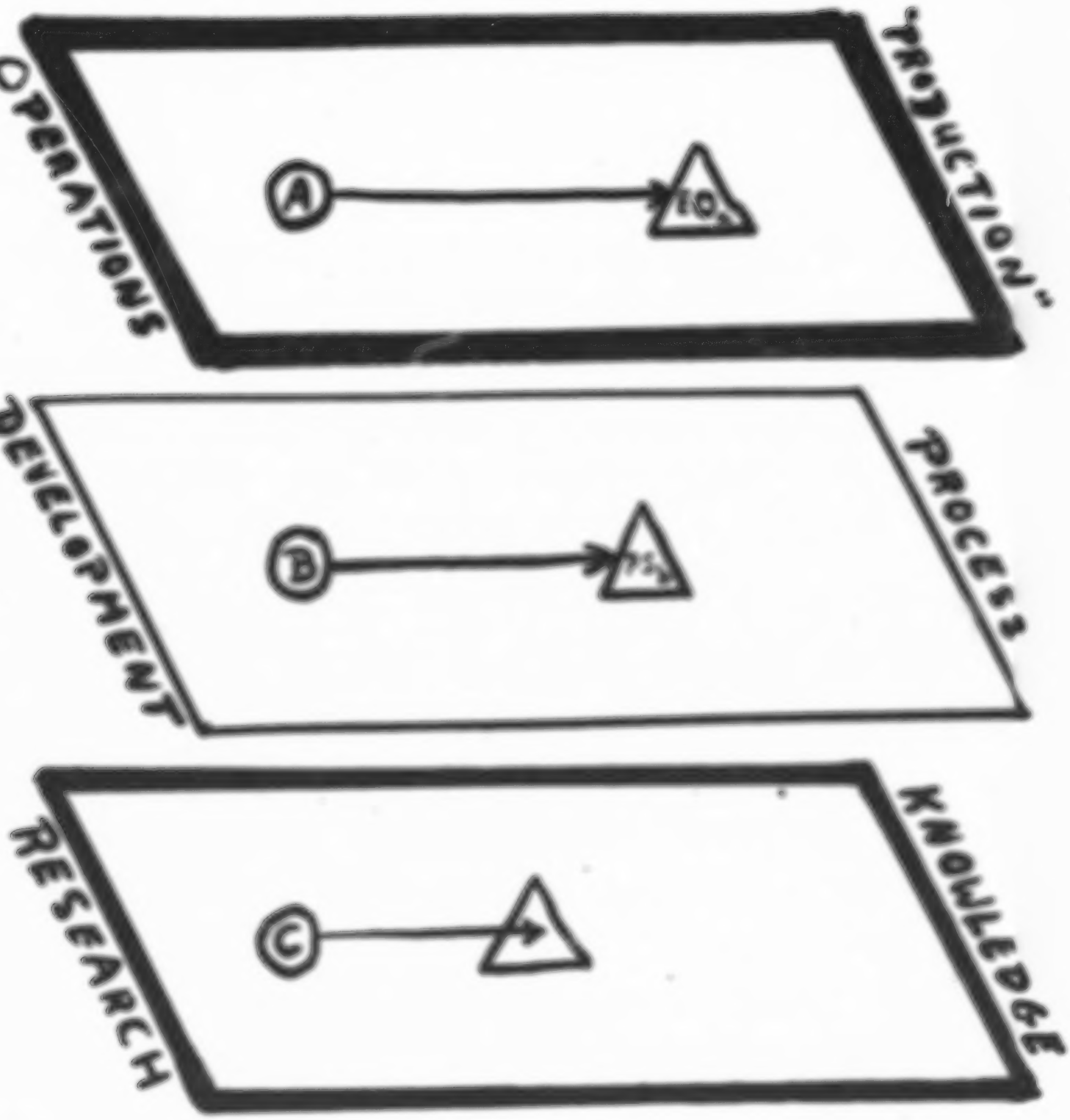

Figure II. An Output Model of Educational Research and Development

For research, C represents an initiative undertaken which culminates in a finding as represented by the arrowhead in the triangle.

The middle plane symbolizes what I call the process orientation of development. The object of development is to produce materials, techniques, processes, hardware, and organizational formats for instruction which accomplish certain pre-specified objectives construed to be part of the broader goals of education. One of the significant features of development is that when an activity is begun, the objective is known or established at the outset. The objectives for a development project are cast in the form of performance specifications (PS), and all activities are geared to producing the necessary products and processes which will meet those specifications. In Figure II, B indicates an initiative undertaken for development culminating in the creation of a process which meets performance specifications PS_B.

The top plane symbolizes the activities characteristic of school operations. The operating educational system is production oriented. The object of school operations is to act upon human beings in order to train and develop in them various skills, attitudes, beliefs, and knowledge systems calculated to serve both society and themselves. Certainly one of the significant features of initiatives in school operations is the weight of the responsibility on the school

administrator for choosing the right kinds of processes to achieve the outputs that the society specifies. In Figure II, A represents an initiative to install a process leading to the production of education output EO_a.

To illustrate the relationships among the three types of activities, consider the following example. A responsible school official, faced with evidence that certain outputs desired by the society are not being achieved for a significant portion of the children in his charge, searches other school operations and ongoing or completed development projects for processes designed to meet his need. Finding nothing to suit his particular problem (e.g., the low reading achievement of culturally disadvantaged children), he exercises his prerogative to call for the initiation of a project to design and develop a process whose performance specifications are such that upon installation of the process in his school, it will yield the desired educational output (e.g., increased level of reading achievement in the target population).

Once the initiative for the development project has been undertaken and the performance specifications established, the development project then conducts a search for relevant research findings which may offer clues to guide the development project. (Whether or not this step is taken after the project is begun or immediately

before is not really important. What is crucial is that at some point near the very beginning of the effort such a search is made.) Impressed with a particular finding (e.g., the tremendous impact of parental attitude on student achievement), the project may decide to develop a process which deliberately tries to engender a large measure of parental involvement in home instructional experiences carefully geared to complementary experiences in the school setting. Having made that decision the developers may then discover that they require further information about the specific nature of optimum parent-child interactions to stimulate maximum learner achievement. They may therefore call for a specific initiative of a research activity to generate further data to guide the development of materials. When useful findings are identified they can be incorporated in the development effort which then proceeds to a successful conclusion. When, using iterative techniques of design, development, trial, and redesign on the basis of feedback, materials encompassing both school experiences and parent-child interactions in the home are successfully developed and validated, they may then be transferred to the operating setting where the administrator may install them as part of his instructional program.

This example is illustrated in terms of the model by Figure III. EO_x at $\phi 1$ symbolizes the social demand for a certain kind of educational output (in the example just given, higher reading achievement for

culturally disadvantaged children). This demand creates pressure on the school administrator to respond with some sort of initiative. That initiative is represented by A at #2. It symbolizes his search for an effective process to install. Since he did not find it, his response was to call for a development initiative (B at #3). The next step was to develop the performance specifications (PS_x at #4) such that they corresponded to the educational output desired by society. Once the specifications for the development project are established the next step is to survey related research seeking guidance for the development effort. That search and the incorporation of the finding (e.g. the significance of parental attitude) into the development project is symbolized by #5 and the solid black arrow from the knowledge produced as an output of research initiative C. The call for additional research assistance is symbolized by D at #6 and the incorporation of the output of that initiative into the development effort is symbolized by the solid black arrow to the development line at #7. Number 8 represents the completion of the development project, #9 the incorporation of the process into school operations, and #10 the production of higher levels of reading achievement as a consequence.

The depiction of a sampling of other possible interactions among research, development, and operations can be found in Figure IV.

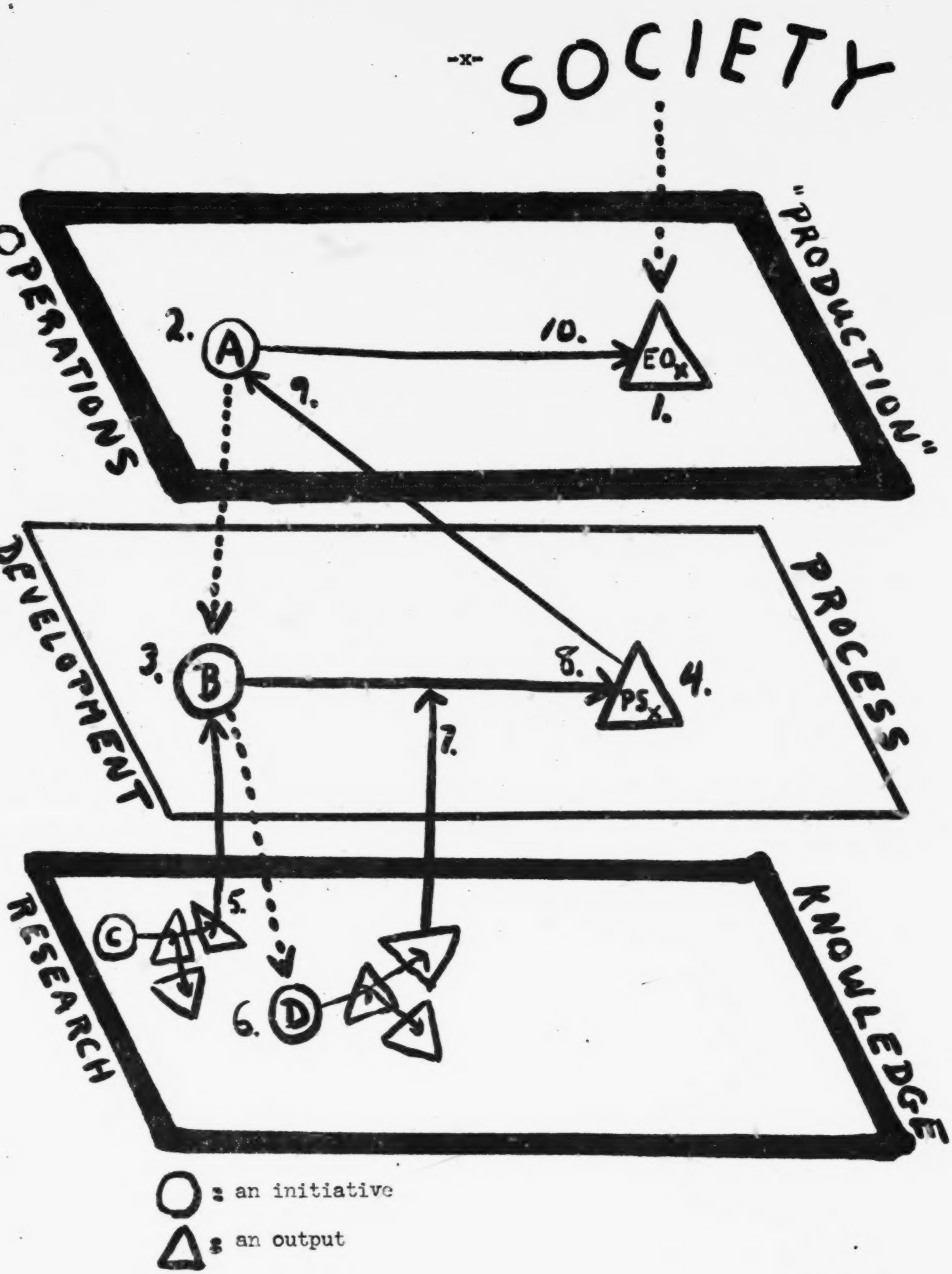

Figure III. A "Walk-Through" of the Model

A school official feels the need to assess the degree to which instructional programs are serving a particular target population. He calls therefore for an initiative in research. This is represented by the A/D interaction.

An organization engaged in development independently concludes that it would be useful to develop a certain process or product for instruction. This is represented by the B/PS_b interaction.

Research is initiated for its own sake and pursued solely for the knowledge which it produces. No findings have yet been incorporated either in development or operations. This is symbolized by initiative C in research.

Research initiated for its own sake produces the finding that certain organizational structures for large city school systems are always problematical or that a certain vitamin supplement administered between the ages of five and seven can prevent a form of mental retardation whose appearance cannot be detected until somewhat later. Neither one of these findings needs to pass through development. Each can be implemented directly in school operations (if so desired). These examples are illustrated by the E/F/EO interaction.

Finally, consider an example in the form of the linear flow or Guba-Clark model from research to development to implementation. Research on early childhood and cognitive growth uncovers a number of findings

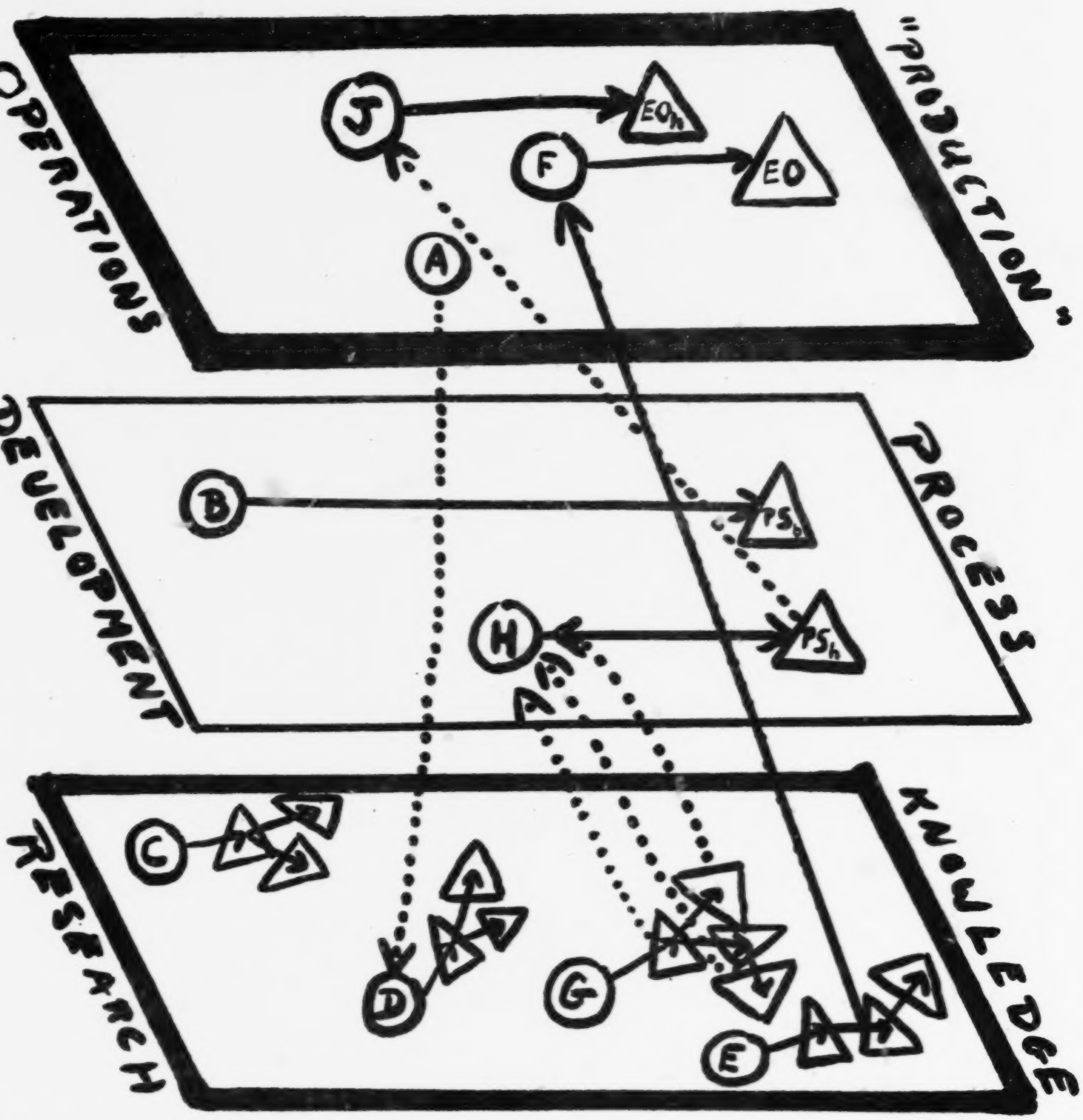

Figure IV. A Sampling of Other Possible Interactions

all of which suggest the development of processes and environments which can actively enhance such growth. Development efforts are consequently supported and carried through to completion and the resulting products and processes are then incorporated in newly developed early childhood instructional programs mounted at private or public expense. This kind of interaction is represented by the $G/H/PS_h/J/EO_h$ interaction.

All of these representations in Figures II, III, and IV are fairly obvious and straightforward. The uses of the model as a heuristic, however, profits from further explanation. One of these uses pertains directly to the problem of "change process" as applied to education. The model is structured to illustrate that the incorporation of research findings into development is just as important and oftentimes as difficult a proposition as incorporating newly developed processes into operational settings. The knowledge that there are obligations on both research and development to transfer their products to other activities means that each must pay careful attention to the way in which its outputs are presented and, in fact, the very way in which the outputs are produced. In other words, the requirement that eventually there be transfer or incorporation into another type of activity places constraints upon the professional behavior in each activity which cannot be ignored without endangering success.

This requirement is particularly true for development projects, but it is as true for research activities. A few concrete examples illustrate the point. A most simple one is the researcher who publishes his findings in a sloppy or difficult format and thereby hinders the likelihood of their being incorporated ultimately into practice. The researcher who inadvertently conceals or compromises his methodology or design encounters similar problems.

Similarly, the ultimate requirement for a development project is that it be usable in operational settings. The ultimate desire to incorporate the developed process in school operations means that one of the performance specifications for development must always be the provision of procedures (teachers' manuals, training procedures, etc.) for accomplishing the installation of the innovations. If the development is undertaken without reference to that fact (if, in short, the requirement for transfer is not built into the performance specifications), the developer may well have rendered his product unusable. Hence, for example, the desire to involve teachers and other practitioners in the development process stems from the need to have their expertise and experience continually represented. They constitute, in effect, the embodiment of the operational constraints within which the finished process will operate. There are other good reasons for involving teachers as well, not the least of them being the respectability lent to the project in the eyes of the

practitioners at large by virtue of the meaningful presence of teachers in the effort. This last consideration is of no small importance in securing acceptance of the innovation in the profession at large. The nature of its importance, however, should not be mistaken; the involvement must be meaningful and not merely window-dressing, for the respectability is lent by their presence only if their contributions are fully utilized.

One final point might be made about the possibility that the model portrays for transfers back and forth among research, development, and operations. That is the obvious emphasis which it suggests need to be given to the problem of information flow and the need for carefully considering techniques for installation of better knowledge and better processes into their intended settings. Only part of this is the direct responsibility of the researchers and the developers. Those with obligations for considering the entire R&D system for improvement need also to direct their attention to the diffusion process.

A second feature of the model as a heuristic is the way it helps to clear up part of the problem of distinguishing between basic and applied research. The model clearly implies that basic research (studies generated independently in research for the sake of the findings alone) and applied research (research conducted to serve a particular need identified by people engaged in development or operations) differ from one another primarily in terms of the intent

of the initiator. Thus the knowledge-orientation of the basic researcher is central to his activity. Applied research is also supported for the knowledge which results from it, but the initiator of the research knows to what instrumental use he is going to put the findings. By depicting both applied and basic research as similar kinds of activities, the model implies that in and of themselves they look very much alike. The procedures, the design, the sophistication must all be on a par if either is to be valuable. What distinguishes the two from one another are the purposes for which they are initiated.

A third feature of the model as a heuristic is that it suggests that decisions to initiate activities of each of the three types are made according to quite different criteria and perhaps by quite different people. The fundamental scientific character of research suggests that independent initiatives exercised there depend heavily on advice from the scientific community. Development projects, however, can also be independently initiated, but decisions to begin these kinds of activities are subject to advice from both research and operations. With limited resources, deciding which needs to satisfy through development (for example, those independently generated by developers, compared to those stemming directly from school operations, compared to those growing out of research activities) becomes a particularly difficult problem. Finally, the kinds of lonely decisions required of school administrators at the operational level are made

by people in the context of quite different circumstances and institutions. By emphasizing the essentially different nature of the activities being undertaken, the model reminds the policy maker of the need to collect different kinds of data and statements of need when planning future activities.

Finally, the frank attempt to represent each of the activities in terms of particular kinds of outputs may well be the most significant aspect of the model. It forces the user of the model to consider what the outputs of each activity are and to think about how the outputs of each activity are of use to one another. The outputs of research, for example, are knowledge. Some of the knowledge produced through research will find its way into development and into school operation. Are there ways of improving the output of research, making it more powerful, increase the likelihood of its being of use to instruction and education?

What about the outputs of development? They constitute the validation of research and the means by which the educational system carries out its functions. How can development be improved, how can research be organized to be of greater use to development, and how can the educational system itself orient its organization to the recurring need for the installation of more powerful validated techniques?

What happens to the educational system itself when it begins to view its responsibilities in terms of output? The contrast can perhaps be most sharply drawn by considering the implications of grading schools on the basis of their outputs rather than students on the basis of their performance. The existing practice of grading students assumes at bottom that the student is responsible for his learning and that his failure or success is a tribute or a consequence of factors intrinsic to him. The idea of grading a school on the basis of its outputs assumes quite to the contrary that all students can learn and that the responsibility of the schools is to make that happen. (We do not, for example, judge the success or failure of medicine or law by the patient's or client's end state; we judge it by the degree to which the doctors or lawyers skillfully utilized the most sophisticated practices in attempting to serve the client. We certainly do not "grade" the patient or client; quite to the contrary, it is the professional services themselves which are assessed. An output orientation for school operations would cause the same reorientation of the direction of assessment in education.) If the schools themselves are judged in terms of the degree to which they are accomplishing their "production goals," increasingly they may come to orient their activities to assessing their own effectiveness, identifying the techniques and processes which need improvement and, as a consequence, calling with increasing sophistication for the kind of development activity and research support which will provide the basis for continuing improvement.